Sandia's International PV Activities: Sustainable Markets Through Strong Partnerships

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ABSTRACT

Sandia National Laboratories has teamed with a variety of partner organizations to open new international markets for the U.S. photovoltaic (PV) industry. Emphasis has been on productive-use applications of PV, such as water pumping, in areas not served by an electric grid. Through the provision of technical assistance, training, and the facilitation of large numbers of pilot projects, the Sandia team builds the capacity of in-country organizations and businesses to specify, procure, use, supply, and maintain PV systems. This establishes a local experience and business base, launching growing markets as the pilot projects are replicated outside the immediate program. The Sandia team monitors the activities and uses the information obtained to improve both the program and the technology, as appropriate. Considerable success in opening new markets has been achieved in Mexico with this approach, and the team is now applying the model in Central America.

1. Introduction

Developing international markets for the U.S. photovoltaic (PV) and other renewable energy industries in partnership with the U.S. government is in the best interests of the U.S, a variety of sources have concluded. As examples, the Report of the Photovoltaic Industry Roadmap Workshop stated that it will be necessary to grow both national and international markets in order to reach the vision and goals laid out in the roadmap exercise, and recommends that this be accomplished through partnerships between industry and government [1]. A report by the President's Committee of Advisors on Science and Technology (PCAST) contains strong recommendations that the U.S. government increase it's involvement in international energy issues, especially regarding the use of renewables in developing countries [2]. The Renewable Energy Policy Project recently concluded that using photovoltaic systems for rural electrification in the developing world provides an important contribution to global climate protection [3]. Developing-country markets have been and continue to be key to maintaining the strength of the U.S. PV industry, although increased competition from the PV industries of other developed countries, with strong support from their governments, is now threatening this situation.

The U.S. Department of Energy has supported the development of new international PV markets through activities at both Sandia National Laboratories and the National Renewable Energy Laboratory (NREL). As the competition in the international arena intensifies, the market development efforts supported by the U.S. DOE will become more important to maintaining the position of the U.S. industry. This paper describes the approach, accomplishments, and future directions of the recent international work led by Sandia in partnership with a variety of other government and non-government organizations.

2. Approach

Sandia has developed a model for its international renewable energy (RE) programs that focuses on developing and strengthening local capacity to implement and maintain RE projects [4]. This approach is a direct extension of the PV Systems Assistance Center (PVSAC) philosophy, which has been in effect at Sandia for almost 20 years. The international program model is built around six tenets:

- *Partnerships,*
- *Capacity building,*
- *Technical assistance,*
- *Pilot project implementation,*
- *Monitoring and evaluation, and*
- *Replication.*

Strong partnerships are the key to sustained success in Sandia's international activities. Sandia uses partnerships on several levels. First, at the program implementation level, Sandia manages a multi-institutional team to address the range of technical, cultural, institutional, and economic issues related to the sustainable use of renewables. Key members of Sandia's international program implementation team include Winrock International, the Southwest Technology Development Institute (SWTDI) at New Mexico State University, Enersol Associates, Ecotourismo y Nuevas Tecnologías, and NREL. This team works closely with U.S. industry, and partnerships are also developed in-country with multi-disciplined development organizations, government organizations, local business, and academia.

Capacity building is accomplished through formal training, such as workshops and seminars, as well as through hands-on experience with pilot projects, including project identification, specification, implementation, operation, and ultimately RE program design.

Technical assistance comes in the form of system specifications, assistance in bid reviews, assessment of renewable resources, and the performance of system acceptance tests. In all program areas, the Sandia team works closely with local equipment suppliers to develop their technical capabilities.

The implementation of pilot projects is used as a tool for institutionalizing the use of RE. The hands-on experience gained through these projects provide in-country partners with the institutional ability to develop appropriate RE applications and to procure and maintain systems in the future. They also help establish connections between the U.S. industry and local business partners.

Monitoring is necessary to ensure the long-tern sustainability of individual systems, provide feedback to members of industry for product improvement, and assess the success of the overall program.

While the pilot projects may result in significant numbers of installed systems, the true measure of success of the program is replication. Replication occurs as the success of the pilot projects becomes known, project implementing organizations and end-users become comfortable procuring and using PV, local businesses gain strength, and financing is made available.

3. The Mexico Renewable Energy Program

Since 1994, Sandia has been applying and refining this program model in the implementation of its Mexico Renewable Energy Program, co-sponsored by the USDOE and the U.S. Agency for International Development (USAID). The Mexico program works with established and funded development programs in Mexico to demonstrate the feasibility of RE technologies in off-grid

productive use applications that offer economic returns to the end users of the systems. With its inclusion in a RE annex of the U.S./Mexico Bi-national Agreement in 1998, the program has facilitated the development of a large portfolio of collaborative RE projects between the two countries.

Through several long-term partnerships with Mexican organizations, the Sandia team has facilitated the implementation of more than 300 RE systems (95% of which are PV) in rural Mexico, representing more than 250 kW of installed capacity. Figure 1 shows the total capacity installed over the life of the program. This trend is shifting from program-sponsored pilot projects, which are being phased out, to replication through new programs and market growth.

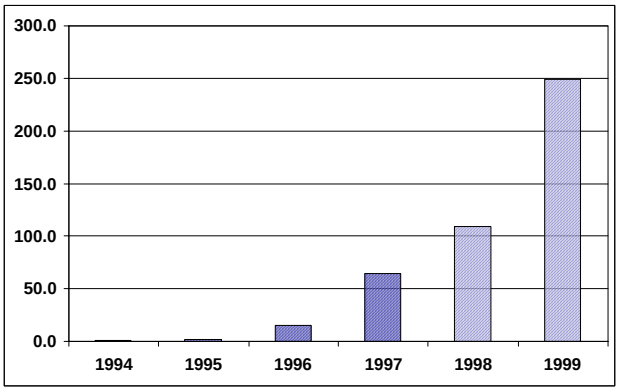

Figure 1: Mexico Program Cumulative Installed kW

Over 175 of these projects are PV water pumping systems, the majority of which are for livestock watering and were installed in partnership with FIRCO, a development organization under the Secretariat of Agriculture. Many other systems (more than 100) have been installed through partnerships with government and non-government organizations involved in the management of protected areas. These include power for ranger stations and research centers, communications systems, and water pumping for communities. In total, more than 100,000 Mexicans are benefiting from these systems.

Through the capacity building and technical assistance activities that have accompanied the implementation of these pilot projects, the Sandia team has trained more than 1600 Mexican engineers, technicians, program implementers, and system suppliers in various aspects of appropriate RE project development. Working with its partners, Sandia has developed technical specifications that have resulted in improved quality and functioning of installed systems. These specifications have been adopted by several organizations throughout Mexico, and are being used in a variety of applications. NREL has developed solar and wind resource maps that have been widely distributed and has used its advanced modeling capabilities to assist in the development of the hybrid systems implemented through the program.

4. Opportunities for U.S. Industry

The Sandia Mexico program has set the stage for significant replication of the pilot projects installed, and U.S. industry is well-positioned to benefit. In the state of Chihuahua, the program has worked with the state government to initiate Mexico's first end-user financing program for both domestic and productive use applications of PV systems. Through a competitively bid award, one U.S. supplier, has already provided more than 150 systems. With assistance from the Sandia team, Winrock International in particular, the Mexican Secretariat of Energy is negotiating with the World Bank and the Global Environment Facility (GEF) to significantly expand on this financing program, with overall investment expected to be in the millions of dollars.

Perhaps the greatest replication success story in Mexico is the first-ever World Bank/GEF program focused on agricultural applications of RE, to be managed and implemented by FIRCO, Sandia's main Mexican partner. This program involves more than $US30 million in investment in RE systems over 5 years. Through the efforts of the Sandia program, several U.S. suppliers have improved their distribution networks and demonstrated their value to FIRCO in many Mexican states. Continued support from the Sandia team will be key to the success of this program.

5. Application of the Model in Central America

The Sandia international program model is now being adapted to provide support to the Central American countries that are still rebuilding in the aftermath of Hurricane Mitch. In April, 1999, Sandia participated in a USDOE/USAID mission to the region to develop a roadmap for sustainable development of the energy sector [5]. The roadmap contains several recommendations for the application of RE technologies, in both on- and off-grid applications. The Sandia team is developing partnerships with government and non-government organizations involved in rural development and local suppliers who wish to develop the capacity to provide technically appropriate, long-lasting systems. This work is sponsored by USAID/Global and the USDOE Office of Technology Access.

Although this Central America program is still in its early stages, several important leveraging opportunities are already under development. Of highest priority are the programs of the USAID missions in the region, which are implementing President Clinton's pledge of $US1B in post-Mitch rebuilding support. Sandia is collaborating with the missions to demonstrate the economic, social, and environmental values of PV and other renewable technologies within their programs. As an example, the Sandia team is providing technical assistance to Fundación Solar, a development organization, and suppliers in Guatemala as they manage the procurement and installation of almost $US1M in PV systems for homes and communities in rural areas. In addition, the World Bank is exploring opportunities for rural electrification in Nicaragua and other countries in the region. Sandia is facilitating informational exchanges between Nicaraguan officials and its Mexican partners involved in the development of the Mexican program. Through its central role in these activities, Sandia plans to build on its successes in Mexico and continue to open new markets for U.S. PV technologies.

6. References

1. U.S. Photovoltaics Industry PV Technology Roadmap Workshop, June 22-25, 1999, Facilitated by the National Center for Photovoltaics (NCPV) for the U.S. PV Industry, (Columbia, MD: Energetics, Incorporated, September 1999).

2. President's Committee of Advisors on Science and Technology (PCAST), Panel on International Cooperation in Energy Research, Development, and Deployment, Powerful Partnerships: The Federal Role in International Cooperation on Energy Innovation, (Washington, DC: Office of Science and Technology Policy, June 1999).

3. Kaufman, S., Et al: Rural Electrification With Solar Energy as a Climate Protection Strategy, (Washington, DC: Renewable Energy Policy Project, January 2000)

4. Richards, E., et al: "Photovoltaics in Mexico: A Model for Increasing the Use of Renewable Energy Systems", Advances in Solar Energy, Vol. 13, (Boulder, CO: American Solar Energy Society, 1999).

5. USAID/USDOE: "Energy Sector Roadmap: Recommendations for the Countries Most Affected by Hurricane Mitch," (July 1999).